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ABSTRACT

The paper examines in depth administrative and instructional uses of the computer in adult education. The author demonstrates: (1) positive findings related to the feasible use of the computer in data analyses and report writing for administrative purposes, and (2) preliminary, yet encouraging, findings in the area of computer managed instruction for Adult Basic Education (ABE) students. The research findings presented are based on a review of the literature, investigation of computer application models, and a two-year computer application in Massachusetts. The described computer application is a response to seven ABE needs identified on several levels which are delineated and discussed in depth in the paper. The body of the paper is divided into two major sections. The first is a discussion of administrative uses of the computer in Adult Education and includes a chart of current ABE administrative computer applications in various States. The second section deals with instructional uses (computer managed and computer assisted instruction) and contains a descriptive chart of major computer managed instruction systems in operation. Within these two broad sections substantial references are made to significant contributions in the field and to the Massachusetts application specifically. A three-page bibliography concludes the report. (Author/MS)

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COMPUTER MODELS IN ADULT EDUCATION

Paper Presented

at

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by

Phyllis A. Paeschke

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NATIONAL INSTITUTE OF EDUCATION

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INTRODUCTION

The use of the computer in Adult Education is very new. Aside from use of the computer in statistical analyses for research, little has been done with this extremely valuable tool in the field of Adult Education. Expense, primarily, but also lack of information, lack of creativity, and lack of stimulation have prohibited development in Adult Education of:

Administrative uses of the computer
and
Instructional uses of the computer

This paper will examine in depth these two little explored areas of computer use in Adult Education. Through a review of the literature, investigation of computer application models, and extensive personal knowledge with an ongoing computer application in the state of Massachusetts, the author will demonstrate: 1. positive findings related to the feasible and worthwhile use of the computer in data analyses and report writing for administrative purposes; 2. preliminary yet encouraging findings in the area of computer managed instruction for Adult Basic Education students.

The research findings presented in this paper are based on: 1. review of the literature in the field; 2. 2-year computer application in Massachusetts in an Adult Basic Education setting. (The Massachusetts computer application is funded by the Bureau of Adult Services under P.L. 93-380, the Adult Education Act, Special Project Funds, Section 309.) The described computer application is a response to needs identified on several levels. A brief delineation of these needs follow. Each will be discussed in depth in the body of the paper.

1. Need on the part of program administrators on a federal, state, and local level for a systems approach to program management.

2. Need for program control by administrators and adult educators.

3. Need for appropriate information at appropriate points for decision making.

4. Need for a cost effective way of gaining control over program operation.

5. Need within an Adult Basic Education Learning Center for a comprehensive approach to program management including: management of attendance, management of student record keeping, and management of learning experiences.

6. Need for significant and effective ways of individualizing education for the Adult Basic Education student--a paramount issue at a learning center servicing a diversified clientele.

7. Need for on-site practitioners to coordinate program research with program operation.

The body of this paper is divided into two major sections: I. a discussion of the administrative uses of the computer in Adult Education, and II. a discussion of the instructional uses of the computer in Adult Education. Within these two broad areas substantial reference will be made to significant contributions in the field and to the Massachusetts application specifically.

I. ADMINISTRATIVE USES OF THE COMPUTER

Problems related to information, whether this be collection, storage, communication, manipulation, analysis, retrieval, and application of information are involved in every educational situation. The mandate for American education in the 80's is clear:

> The continued use of antiquated information processing procedures in the face of the growing size and complexity of American education constitutes a gross anachronism. Education is in large measure an information processing system. The right data at the right moments give teachers and administrators the edge they need for making calculated rather than uninformed decisions. Wisdom and information are a powerful team. Computers can provide the information, educators must provide the wisdom. We have seen that American education today involves billions of dollars and millions of people, changing curricula, new patterns of school organization, more effective means of supplying and using materials, and diverse decisions about instruction and administration. The problems range from counting things and people to matching things and people; from studying things and people to simulating relationships among things and people; from a concern over deliberately controlling things and people to speculating about things and people. Educational Data Processing plays a potentially powerful but presently too neglected role in all these. (Goodlad, O'Toole and Tyler, 1966.)

Computer use and growth in the educational sphere have been comparable to that within the business world. The expansion of the computer use in the last 5 years within the secondary school setting is reflected in Exhibit 1 , taken from a paper presentation at a 1975 conference on educational computer applications. Gains are reflected in both administrative and instructional uses of the computer, although administrative growth has been much greater. This is partially explained by the fact that computer instruction developments are still really in the infancy stages. Educational data processing in the administrative area for fiscal accounting are far more familiar and have had direct models in the business world.

Exhibit 1

"COMPUTER APPLICATIONS IN SECONDARY EDUCATION"

Secondary School Survey

	1970	1975
Secondary Schools Using Computers	34.4%	52.7%
(Admin. only)	21.5%	29.5%
(Instruc. only)	3.9%	4.5%
(Both Admin. & Instruc.)	9.0%	18.7%
Nonusers	65.5%	47.3%

(Korotkin & Bukoski in Green, editor, 1975.)

In an attempt to formulate possible suggestions for future directions computer applications in education might take, a USOE Ad Hoc Study Group in 1969 after extensive study of such application in the 60's formulated several recommendations:

1. Of several kinds of computer applications being researched, some should become operationally feasible before others.

2. With existing hardware, many of the more exotic applications (CAI, CMI and Computer Based Guidance Systems) would not become feasible for wide-spread school use unless significant reductions could be made in per student cost.

3. A number of non-exotic but useful functions exist which could be furnished with available technology.

4. Current systems should be developed to provide services currently available and accomodate expected newer functions at a future time with minimum disruption and system modification.

5. Services provided probably should not increase per student cost by more than 2%.

On the basis of this USOE Ad Hoc Study Group, contracts were awarded: 1. to study the questions raised concerning applications most feasible for education and 2. to investigate further coordination and consolidation of applications. Studies completed indicated that without extensive further research and development, certain services could be provided including: administrative data processing, courses in computer technology, integrated problem solving and vocational training. The studies assumed computer managed instruction, guidance and library services should be added on later. (Morgan, 1969.)

By the mid 70's, computer technology has advanced to the point where the needs of most educational administrators in the area of information retrieval can be met. The tremendous gap often perceived by educators between technological

potential and delivery is a result of two problems: 1. a lack of conceptualizing educational functions and operations into a comprehensive information management system and 2. the absence of trained professional educators and support personnel to apply existing computer technology to solve information problems. The purpose of this paper is to suggest that the tremendous gap between technological potential and delivery is being bridged. Specific examples of educational computer applications which demonstrate success in responding to administrative and instructional needs will be examined in an effort to advance the application of this powerful technology to problems in adult education.

ADMINISTRATIVE COMPUTER APPLICATIONS IN ADULT BASIC EDUCATION

The national Adult Basic Education endeavor has come under increasing scrutiny in terms of accountability for delivery of services. The General Accounting Office in its 1975 report to Congress commented upon "statistics compiled at the local program level, and ultimately reported to the Office of Education and summarized nationally, which have been unreliable and have overstated program accomplishments." The General Accounting Office recommended strongly that program reporting data be improved. (GAO, 1975)

Requests by the USOE for improved data collection, coupled with increasingly complex and demanding reporting forms, and stress on accountability have prompted some states to use a computerized data collection, analysis, and retrieval system coupled with overall improved management information systems. Using responses to a brief survey letter sent by the author to federal regional officers and state adminstrators of ABE programs, the author found the following:

-- Several states have used the computer for research purposes notably in the area of statewide needs assessments of potential adult education audiences and of adult educators for staff development.

-- Three states (Arizona, Texas, and Wisconsin) are using computer analysis for all aspects of data required for annual federal performance report and for data of interest to state agencies.

-- Two states (Massachusetts and Rhode Island) are using the computer for analysis and reporting performance data on clients.

-- One state (Arkansas) is using the computer to analyze data on adult education staff.

-- Several states expressed interest in future computerization of data collection.

Reasons for computerization of program data as expressed by the responding states included: need for a comprehensive, easy method for generating reliable

accurate data on program participants; need for a system to handle voluminous data; need for program information in a timely and understandable fashion. Two modes of data collection exist: batch and time-sharing. Rhode Island, Texas, Arizona, and Arkansas are currently using a batch mode. Massachusetts is employing a time-sharing mode. The batch mode, especially remote batch mode, represents the most cost-effective means of analyzing and reporting program data. The time-sharing mode, though more expensive, enables a greater flexibility in delivery of more varied reports. In the case of the Massachusetts Application, being on-line enables the learning centers on the computer network to use the resources of the computer continually for: ad hoc manipulation of data and report writing, computer managed instruction through generation of learning prescription, and access to a guidance information system for college and vocational counseling. A summary report of states using computerized data analysis is furnished in Exhibit 2.

A concern for a systems approach to program management and computerized data collection, analysis, and retrieval systems has prompted the author to prepare a generic system design suitable for an ABE system. This system design is included in Exhibits 3 and 4.

Exhibit 2

CURRENT ABE ADMINISTRATIVE COMPUTER APPLICATIONS

	MASSACHUSETTS	RHODE ISLAND
I. Mode of Application	Time Sharing/Decentralized	Batch/Centralized
II. Computer Center	Computer (PDP 11/50) and Data Banks housed at Springfield Math Department/all data base is initiated and maintained by Centers.	Computer and Data Banks at the University of Rhode Island; Collection, analysis and retrieval of data at Computer Center.
III. Quantity of Data Collected	Data on 7,385 clients at 7 sites in a state.	Data on 4,000-5,000 clients in FY 1975.
IV. Staffing for Project	Director of Project (part-time responsibility) Supervisor of Math Department (consultant & part-time) Program Supervisor (student part-time) Field Coordinator (full-time on project with other responsibilities additionally)	Director of Curriculum Center (1/16 of responsibility) for Project. Work study students at University of Rhode Island (pick up & delivery of reports.) Programmer (part-time)
V. Turn Around Time on Reports	Immediate access for all reports.	Basic report generated each month and sent to centers. State reports generated every 3 months.

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Exhibit 2 cont'd

	MASSACHUSETTS	RHODE ISLAND
VI. Reports Generated	1. Year-end report. All sections of year-end report (excluding staffing & financial) 2. Attendance reports 3. Other reports to various agencies such as referral groups, Win, Vets, local school department 4. Dropout analysis (possible to look at factors related to inactivation) 5. Various other ad hoc reports are generated	1. Year-end report. All sections (excluding impact data category, staffing & financial) 2. Attendance reports 3. Dropout analysis
VII. Data Input	In time-sharing mode, the user (i.e. Center) is responsible for data input, manipulation, and retrieval.	Center teachers turn in completed standardized form monthly to messenger service. At computer center, data is inputed, manipulated and retrieved.
VIII. Staff Development and Training Required	Center Directors (training in management of a computerized data system) Terminal Operators (often originally receptionist or clerical person -- continuous hands on training for operation of terminal) Counselors (management training on use of reports) Teachers, paraprofessionals training on what data is to be collected and what flow of data is to be.	Center Directors and teachers are trained for completion of data forms and interpretation of reports.

Exhibit 2 cont'd

	MASSACHUSETTS	RHODE ISLAND
IX. Mode of Staff Development and Training	Mobile field coordinator, visiting Centers on periodic basis, trouble shooting.	Director of curriculum center visits centers initially for training, at a median point and for subsequent problems.
X. Additional Components of Application	1. Computer managed instruction. Learning centers are developing prescription writer for individualized learning in all areas of A.B.E./G.E.D. instruction. Program has been in effect in Springfield for the last 2 years. 2. Guidance Information system for vocational and guidance of students in college.	1. Not possible. As project currently exists. 2. Not possible. As project currently exists.

Exhibit 2 cont'd

	TEXAS	ARIZONA
I. Mode of Application	Batch/Centralized	Batch/Centralized
II. Computer Center	Not available	A Honeywell 6060 in Arizona State Department of Education is used on a time-sharing basis along with other departments in the State Dept. of Education.
III. Quantity of Data Collected	Data on 105,000 adult participants	Data on 8,922 clients Data on 760 staff members
IV. Staffing for Project	Not available	Assistant Director of the Adult Education Division has responsibility for operation of application.
V. Turn Around Time on Reports	Data submitted at close of classes	1. Attendance data submitted monthly 2. Client registration and separation forms submitted as appropriate 3. Staff registration form submitted as appropriate
VI. Reports Generated	1. All sections of federal year-end report including data on clients & staff 2. Using SPSS, statistical analysis on student composition & comparative analysis between staff and students	1. All sections of federal year-end report including data on clients and staff 2. Cumulative attendance reports
VII. Data Input	Center teachers & administrators mail in standardized class report forms after termination of the course.	Center teachers & administrators mail in standardized forms monthly or with change in data. At State Department, data is inputed, manipulated and retrieved.

Exhibit 2 cont'd

	TEXAS	ARIZONA
VIII. Staff Development and Training Required	1. On site staff training 2. Detailed instruction form	1. On site staff training 2. Detailed instruction form
IX. Mode of Staff Development and Training	Not available	Not available
X. Additional Components of Application	Use of SPSS to analyze much of the on-hand data on students & staff after federal report is generated.	Data compiled is beyond that merely required for federal report and includes other very useful information for program operation.

Exhibit 2 cont'd

		ARKANSAS
I.	Mode of Application	Batch/Centralized
II.	Computer Center	Not available
III.	Quantity of Data Collected	Data collection on all adult education personnel
IV.	Staffing for Project	Not available
V.	Turn Around Time of Report	Federal year-end report on all staff personnel is generated at end of year
VI.	Reports Generated	Federal year-end report data on staff personnel is generated at end of year
VII.	Data Input	Standardized questionnaire completed by all personnel and mailed in to Center
VIII.	Staff Development & Training Required	1. Instructions included on standardized questionnaire
IX.	Mode of Staff Development & Training	Not available
X.	Additional Components of Application	---

Exhibit 3

SYSTEM DESIGN OF A STATEWIDE ABE COMPUTERIZED
DATA COLLECTION, ANALYSIS, AND RETRIEVAL SYSTEM

I. CONCEPTION

1. Goal Setting - establish goals of federal, state, and local agencies for project.

II. RESEARCH

1. Gather reporting forms and reporting requirements of federal agency, state agency, local agency, and individual learning sites.
2. Research similar systems in industrial and educational setting.
3. Determine information sought for reporting purposes.
4. Determine time requirements for reporting.
5. Research most cost effective approach to data analyis and report writing.

III. DECISION

1. Decide on most cost effective computer system for data analysis and retrieval requirements.

IV. DESIGN

1. Design computer configuration for data analysis and retrieval.
2. Design personnel and staffing requirements necessary for implementation of the application.
3. Design system flow including data collection procedures, report generation, and report dissemination procedures.

V. DECISION

1. Decide on adequacy of design.
2. Decide on suitable computer facility with appropriate hardware and software for computer application. (Most likely this decision will be based on competitive bidding.)

VI. DEVELOPMENT

1. Develop data gathering instruments.
2. Develop collection procedures for instruments.
3. Develop dissemination procedures.
4. Develop computer documentation.

Exhibit 3 cont'd

VII. TESTING

1. Computer program debugging.
2. Field Test instruments at selected sites.
3. Field Test data collection procedures at selected sites.
4. Field Test reports and dissemination procedures at selected sites.
5. Obtain feedback from local, state, and federal agencies.

VIII. IMPLEMENTATION

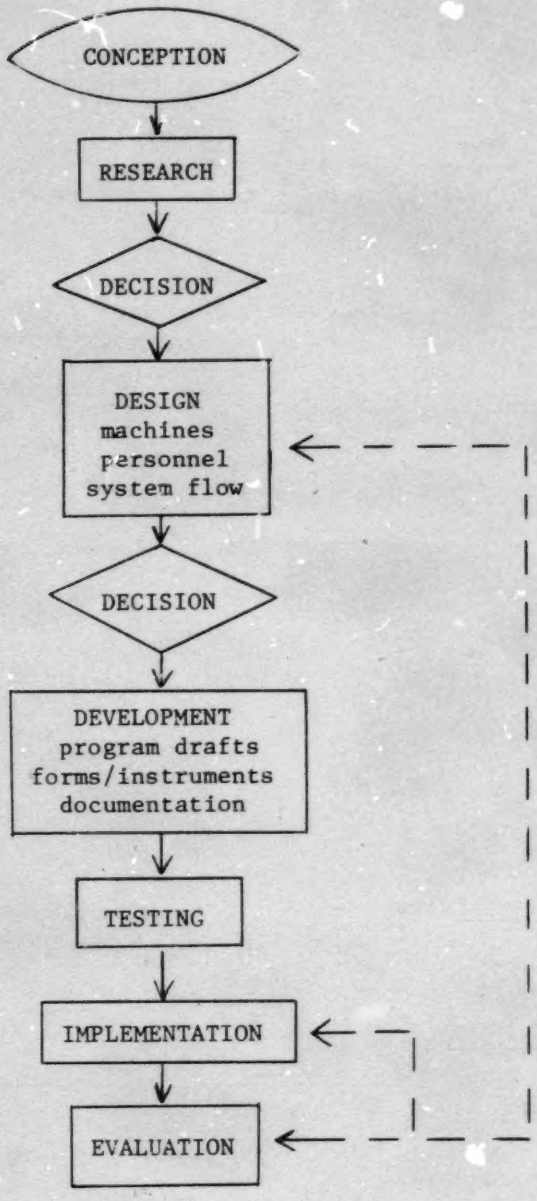
1. Implement data collection, analysis, and retrieval system for all sites.
2. Implement staff development needed to maintain the system.

IX. EVALUATION

1. Evaluate system design.
2. Evaluate system implementation.
3. Evaluate report collection and generation.

Exhibit 4

FLOWCHART SHOWING COMPUTERIZED
DATA COLLECTION, ANALYSIS, AND RETRIEVAL SYSTEM



ADMINISTRATIVE USES OF THE COMPUTER IN MASSACHUSETTS

The administrative uses of the computer in Massachusetts application include: attendance and student record accounting. Since this is a decentralized time-sharing application, each center is responsible for input, manipulation, and retrieval of data. Centers are on-line continually during all hours of center operation. Therefore, access to information is immediate. Reports are generated at each center's terminal.

Some problems have been encountered in connection with the application including: 1. center frustration with computer down-time and other hardware problems, and 2. high degree of training required for terminal operators to input data, maintain data files, and retrieve data.

The hardware configuration of the application includes: a Digital Equipment PDP 11/50 computer, housed in the Mathematics Department of the Springfield Public Schools, disc storage, magnetic tape backup systems, and Digital Equipment Decwriter terminals, Model LA 30 at each learning center on the network. Software has been written specifically for the system by talented high school student programmers in the Springfield Public Schools using Basic-Plus as a language.

Exhibit 5 is a flowchart of all aspects of the application. Log-in procedures include several levels of security built into the system to maintain the strictest confidentiality of student records. Access to student attendance or record file is by unique identifying student number.

Six major programs are operational in the system:

I. Systat - a program which describes the status of the learning center network including which centers are on-line and what program they are running.

II. News - a program which permits communication via written messages for all users on the network and the computer center.

III. Attend - an administrative program which handles all student attendance keeping.

IV. Record - an administrative program which handles all student record keeping.

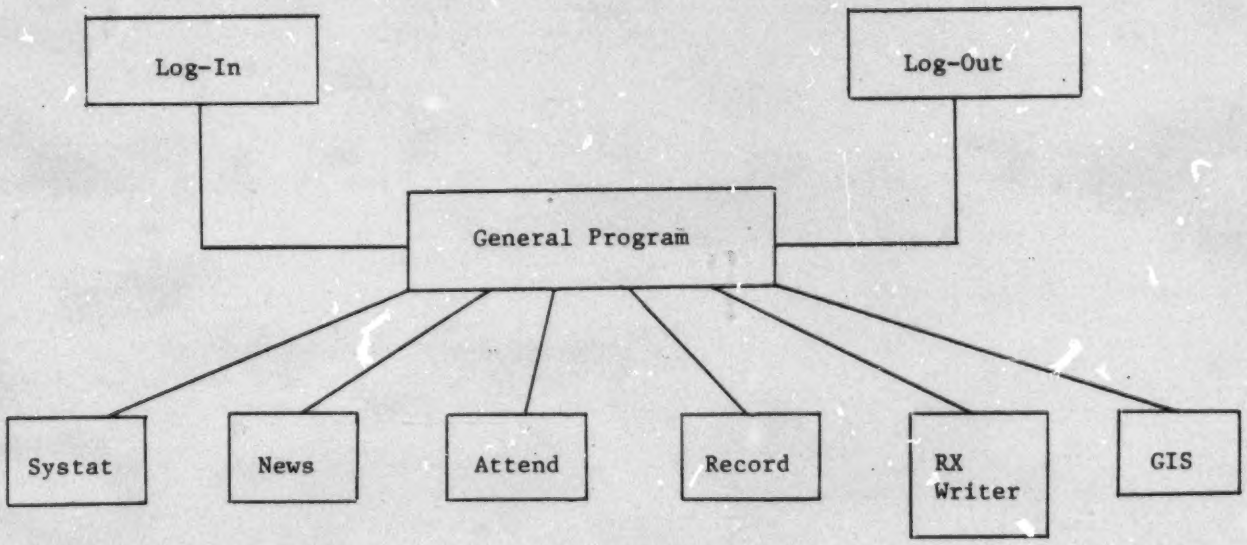
V. RX writer - an instructional program which handles computer managed instruction learning prescriptions.

VI. GIS - a Guidance Information System which is used in vocational and college counseling of students.

The following several sections describe in detail the Massachusetts computer application for administrative purposes.

Exhibit 5

FLOWCHART
OF
MASSACHUSETTS COMPUTER APPLICATION



1. Historical Information

The present Massachusetts computer application for adult education started in Springfield, Massachusetts in the spring of 1971. The Springfield adult learning center sought an optimal method for generating individualized learning activies to match the diverse needs of its adult clientele. Through the collective efforts of the OWL staff, the mathematics supervisor in Springfield, and high school programmers, a computer application was designed to respond to this need through the use of computerized learning prescriptions. An additional program was written to handle the attendance data for these students. Computer technology was thus employed initially for instructional purposes.

A terminal at the center was connected by phone lines to Time Share Corporation in Hanover, New Hampshire. Within a few months, the school department purchased a small Digital computer and the OWL center was then connected to this computer.

The opportunity for expansion of the application to other Massachusetts Adult Learning Centers came in January 1974. A project was written by the Springfield Director of Adult Education and the Mathematics Supervisor and funded by the State Department of Adult Education to include 6 other centers in a statewide computer network. These learning centers are spread geographically throughout the state. The computer network for adult learning centers was approved in March 1974 by the State and by the Springfield School Department and total involvement began at the end of June. In June of 1974, the fundamental nature of the project, a time-sharing application linking 7 centers to the computer housed in the mathematics department of the Springfield Public Schools, was established. The scope of the project included both administrative and instructional uses of the computer.

YEAR I IMPLEMENTATION

Year I, FY 1975, implementation of the computer application included the following:

1. Training sessions and workshops for the purpose of preparing learning center staffs, directors, and terminal operators.

2. Development and implementation of two major record keeping programs to handle student attendance and student demographic information for local, state, and federal reports.

3. Installation of new and more sophisticated hardware for the application including a Digital PDP 11/50 computer and Decwriter terminals providing the learning centers with increased capacity and service.

4. Improvement of OWL center's individual prescriptive programming.

YEAR II IMPLEMENTATION

Year II, FY 1976, implementation of the computer application includes the following:

1. Strengthening of administrative and educational uses of the computer at the centers currently on the network.

2. Development and use of a more flexible prescriptive writer for use of all centers.

3. Training of center directors, center staff, and terminal operators and on-site trouble shooting by a mobile field coordinator.

2. Overview of the Application

The Massachusetts computer network includes 7 comprehensive learning centers using predominantly individualized instruction to service annually some 8,000 clients with less than a high school degree. Each center is unique in physical plant, staff composition, student population, materials and atmosphere, but commonalities include: Clientele, an adult basic education population, predominantly individualized instruction, various administrative routines related to management of instructional program, and management of program data.

According to Feldhusen (1970): "Computers are useful where 1. significant time-consuming, repetition and voluminous quantities of data and facts exist and 2. where not so simple but significantly more complex calculations and logical determinations are to be made." These two statements aptly describe the two roles the computer is performing for the adult learning centers. The computer is being used as a management tool in both the areas of administration and instruction. Voluminous quantities of data are being endlessly manipulated to provide information at various decision making points.

Since June 1974, the seven learning centers have been tied by time-sharing computer system, a Digital Equipment PDP 11/50 in Springfield, Mass. Emphasis in the time-sharing application is on the user who initiates the routines and has responsibility for data input, update, and retrieval. The advantages of time-sharing are several: one set of computer programs are used and one computer center is used. For the learning centers, immediate accessibility to information, the use of already existing staffs, and the preservation of individual center uniqueness are other advantages. A major plus of the time-sharing application, beyond the cost savings, since it is the ultimately economical use of a large computer, is that it allows creativity in development to be widely available and

shared, the computer also provides a linking function, bringing together the various centers in the system for exchange of center developments and news.

The predominant goal of the computer project is to provide a computerized system comprehensive enough to encompass all aspects of learning center management. The three main areas of management are: 1. the management of the curriculum to individualize instruction and respond to adult needs; 2. the management of student record keeping data to write reports for center, local, state and federal agencies; 3. the management of student attendance data. A brief description of these three aspects of computerized management follows.

The individualization of instruction is achieved through a computerized curriculum prescription writer. All curricular materials are broken down and entered into the computer within the meaningful framework of subject, class, topic and level. The computer provides the necessary role of memory and variations of this memory, thereby freeing the teacher to perform the unique role of which the teacher is capable. The teacher diagnoses student needs and then turns to the computer to ask for the best materials and the best combination of these materials to respond to identified student needs. The prescriptions generated by the computer as identified by the teacher form the learning activities in which a student engages during his or her program at the center.

The record keeping program has been designed around the needs of the learning center to include: need for a computerized system to store, manipulate, and analyze large quantities of demographic information and need for an ultimately flexible system to write reports based on such data for numerous and varied agencies and requests. Computerized management of this record keeping is highly desirable from the standpoint of data reliability and accessibility.

Student attendance has always been a great concern to the learning centers. The thrust of the attendance keeping program is twofold: accurate data on

individual student attendance, and overall data of center utilization patterns. Analysis of individual attendance provides information for counseling, follow-up of students, and testing. Overall center attendance is analyzed for center staffing needs and various other management decisions.

The comprehensive nature of the application comes from the interaction of the three above described programs. For each student attendance data is integrally linked 1. to record keeping information and 2. to the learning prescriptions the student is engaged in. For the center data as a whole, linkages have been established between student attendance, student record information, and student learning activities. Access to all information is continually on-line for constant retrieval.

3. Overview of Record Accounting System

The focus of the record keeping system is the storage, manipulation, and retrieval of student record keeping information. The student record keeping file is a reflection of a given center. Each center defines its own file from a set of available categories. These categories include: name, address, telephone number, social security number, identifying group, date of birth, sex, race, level, first language, former elementary grade level, nationality, tests, program goals, assigned teacher, impact data, and reasons for separation.

The file categories have been selected for numerous reasons: data required by various reporting agancies such as US Office of Education, State Department of Adult Education, local education agencies, other referral agancies, data of interest to the center itself.

Certain of the record file categories are self-explanatory while others require a closer look. Group refers to any referral group or subpopulation a center may wish to identify such as Veteran, CETA, refugees etc. Level, as the file records it, includes entering level, present level, and departure level. Former grade level refers to the grade at which the adult left school or the last formal grade level. The test category is user-defined to include all the tests a center may administer for various reasons such as placement tests, median tests, and termination tests. Program goals include reasons for program participation. The centers are comprehensive enough in program offerings that an individual may be attending to learn English as a second language, complete eighth grade, or complete high school. The categories impact data and reasons for separation are functional enough to encompass both the program impact that federal agencies wish to measure and the impact that the learning center itself is seeking to measure. From the categories available, a learning center selects which categories it wishes to store on its students. Certain categories, such as

birthdate, accept only specified information, while other categories such as referral group, first language, tests, impact data, separation data are user-defined to reflect a center's needs and its unique adult education population.

Needless to say for the record keeping system, the file selection is the single most important activity a center engages in for two reasons: 1. proper manipulation of the data depends on the composition of the file and 2. all reports are directly dependent on the contents of the file. Changes in the once-established file may be made to add, alter or delete user-defined items.

Using a student number, explicitly assigned by the center staff to be unique to the individual student, data on a given student is added to the file entering appropriate responses to information questions. Later, information on a student can be updated, corrected or deleted. Student records can move from active to inactive status or vice versa.

Record data can be retrieved on individual student records, the entire center's records, or selected groups of students at particular sites. The print-out of the records can be as complete as the entire student record and all that is stored there or it can be as minimal as simply the name and student number. Any characteristic or category stored can be masked out, that is not printed.

For the retrieval of data, the maximum flexibility is gained through sorting the record file for any single category or a combination of categories. Selected numerical categories of stored information can be printed out in detail or totaled for various local, state, and federal reports. Beyond the writing of reports, the sort function provides an excellent technique for analyzing the reason for inactivation by examining selected categories of data stored on students. One may examine how many students inactivated by program goal, referral group, satellite program, sex, age, or any combination of these categories. Many other on-site research questions can be thus approached by centers.

A comprehensive annual performance report on overall center attendance, program activities, and program impact required by state and federal agencies is generated by the computer. The report includes several tables requesting a breakdown by age, sex, race of total participants, a breakdown of levels of participants, an analysis of program impact by selected characteristics, and an analysis of reasons for separation from the program.

A brief summary of the reports generated by the record program and some center uses of the reports follow in Exhibit 6.

Exhibit 6

RECORD PROGRAM REPORTS

REPORT GENERATED	CENTER USES REPORT
I. Report by student number of student record.	I. To examine student record.
II. Report of total number or by detailed student records of any characteristic or combination of characteristics stored in the record file.	II. a. To examine program composition by any selected demographic characteristic. b. to examine program status relating active and inactive status to selected demographic characteristic.
III. Overall report of center composition by age, sex, race, participating level, impact data, and reasons for separation.	III. To submit to state and federal agencies as annual program performance report.
IV. Report of student numbers used and available with total numbers of active students.	IV. To account for assigned and unassigned student numbers and to account for status of student body relative to active or inactive status.

4. Overview of Attendance Accounting System

Adult Basic Education centers are concerned about client attendance for several reasons. Research findings have shown that the population least likely to participate in adult education and to complete adult education programs are those with less than a high school degree and of lower socio-economic levels. Therefore, Adult Basic Education, a federally funded and legislated compensatory education program for this large group of adults who lack in the fundamental literacy and computational skills necessary for full participation in the society, is extremely concerned about attendance data. Other reasons for center concern about attendance follow. Students are sometimes funded by referral agencies on the basis of participating days and hours. Funding for programs is often connected with attendance data.

The attendance keeping system functions to maintain cumulative and individual attendance records for the center. Attendance data is stored, manipulated, and accessed in several forms. Monthly attendance files are initialized. Daily student attendance using a student number explicitly assigned by the center staff to be unique to that individual student is inputed by date with student time in and out entered. The attendance data and amount of time spent in the program by the students enters a cumulative individual student record and also a cumulative center attendance record.

Information on a single student's attendance may be accessed which enables one to check a student's attendance record month by month and attain a total number of appearances and hours. This function is used most frequently to provide a printout of attendance data for referral agencies who desire weekly or biweekly data on students.

A student's cumulative attending hours are accessed in several other ways. A center may retrieve the names of those students who have participated for any designated number of hours in the program and do median testing or counseling. A center is often seeking data on progress. Progress may be measured by student testing after a certain number of participating hours. The interval hours may vary depending on the program goal of the student: ABE, GED, ESL or the functional level of the student within these programs. Another function which accesses cumulative student participation examines the cumulative participating hours of a student during the fiscal year of July 1 - June 30 and weighs this data against other categories of information such as student program, functioning level within the program.

To examine overall center attendance, the attendance program contains three functions for the retrieval of this overall center data. One may obtain summary data on a center's overall attendance and number of student participating hours. Exception reports are generated showing students who are absent for a specified amount of time, be it one day, one week, or a month. The data provided by an analysis of those students absent for any month provides initial information for immediate counselor follow-up of those students. Ideally, the counselor would examine the print-out of those students absent during a month and take appropriate action such as: inactivitation of students who have left the program and followup of potential program drop-outs.

Reports on a monthly basis for overall center attendance are generated for state and federal agencies. These reports include a listing by number of absent students and a listing by number of the students present, with date and amount of participation.

A summary listing of reports generated and center uses of these reports follow in Exhibit 7.

Exhibit 7

ATTENDANCE PROGRAM REPORTS

I. Individual student attendance report broken down by month, day, and time, totaling number of appearances and amount of participation time.	I. a. to observe student participation pattern. b. to submit to various referral agencies requiring attendance reports.
II. Report of students by name and number giving those student who have participated for a designated number of hours in the program	II. a. to do median testing b. to identify student progress correlated with hours of participation in the program.
III. Report of student by name and number giving the cumulative number of participation hours within a fiscal year.	III. To identify by student the number of participating hours.
IV. Cumulative monthly report on student attendance.	IV. a. to provide a complete record of student attendance by month. b. to furnish state with cumulative monthly attendance record.
V. Report of students absent for month.	V. To identify students who have been absent for a specified period for follow-up purposes.
VI. Report of students present for month.	VI. a. to identify by student number student who have been present during a month with participating dates and hours of attendance. b. to obtain a graph of overall center usage during a month.
VII. Report of center attendance by month and day.	VII. a. to obtain an overview of center attendance by month and day. b. to obtain a graphic picture of attendance patterns within half-hour period of a day.

II. INSTRUCTIONAL USES OF THE COMPUTER

Computer technology has been applied to the instructional process since the 60's. The mid 60's witnessed the largest number of applications in this area. The applications of the 60's almost exclusively involved Computer Assisted Instruction using the computer integrally in direct interaction with students. Mitzel (1974) states several reasons why CAI specifically and computers in general have not fulfilled promises held for them ten years ago:

> Some possible explanations for the delay in the application of computer technology include the following overly simplified notions; 1. too much capital required for massive equipment acquisition; 2. lack of adaptability of business-oriented hardware to instructing functions; 3. an overly decentralized education market; 4. the lack of resources for developing even minimal amounts of computer based course material; 5. a skeptical, anti-technology attitude on the part of teachers and other educators.

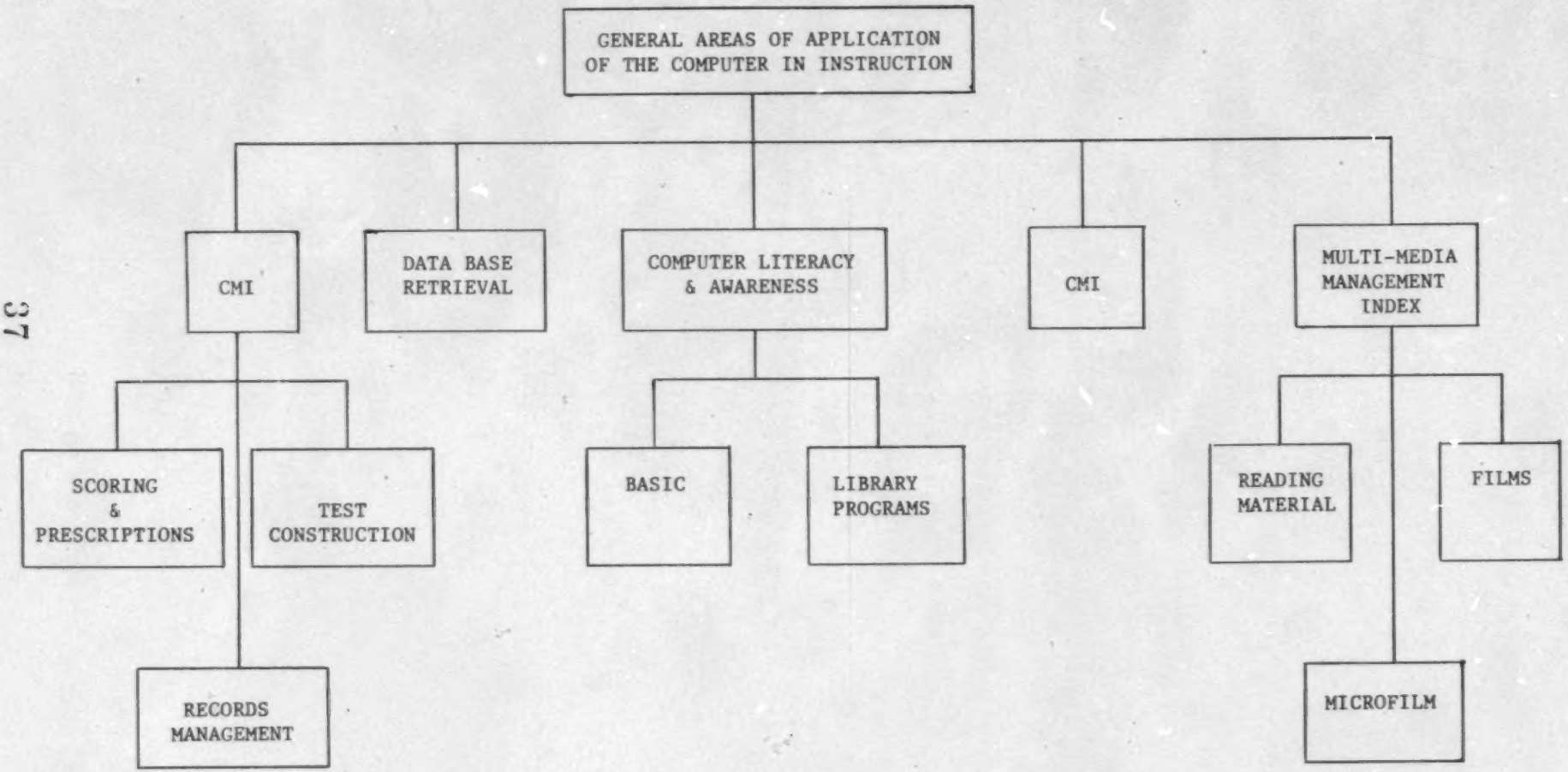
Researchers, teachers, and administrators have come to feel that with the emphasis of the 60's in getting students involved in direct interaction with computer technology, more immediate, feasible, and cost-effective applications of computers to the instructional process, namely computer managed instruction may have been overlooked. In general since the 60's the spectrum of computer applications in the area of instruction has expanded considerably.

Morrissey and others have divided the current status of such computer application to instruction to 5 major areas: Computer Managed Instruction, Computer Assisted Instruction, Data Base Retrieval, computer literacy and awareness, multimedia management index. A general diagram of these dimensions is contained in Exhibit 8 . CMI and CAI have the longest history in the area of computer applications in education. These two terms will be defined in detail and described in depth in this section. Data base retrieval refers to use of the computer to

conduct searches through vast amounts of material such as library references using a few key words or numbered characteristics. Multimedia management index is very similar to data base retrieval in that the computer references all types of supporting media material. Computer literacy is a very new dimension of computer applications and is designed to effect more worthwhile uses of the computer by preparing people to employ maximally computer technology.

Morgan (1974) relates computer literacy training presently underway in the Montgomery Public Schools. In the very near future many more individuals in the United States will be in occupations directly related to the computer. Mini-courses for K-12 have been designed around: "How the Computer Works, Vocational and Social Implications of Computers and Learning a Programming Language and Using it for Problem Solving," to respond to the growing role computers will play in the future.

Exhibit 8



(Morrissey in Green, ed., 1975)

An immediate distinction needs to be drawn between computer assisted instruction (CAI) and computer managed instruction (CMI) or computer based instructional management systems (CBIMS). CAI employs the computer as a teaching tool with the student on-line at a terminal interacting directly with the computer. The sequence of events which generally occurs in CAI follows:

1. Information and material is presented to the student at a terminal which serves as an input/output device.
2. Student responses occur and are processed.
3. Appropriate feedback is provided by the computer to the student.
4. The computer exerts control over the sequence and presentation of material.

By contrast with CAI, machine/student interface is usually not characteristic of CMI or CBIMS. Therefore, the number of interactive terminal drops considerably, so also do hardware costs since CMI systems do not necessarily have to be on-line. The striking difference between the two systems is the use of the computer: in CAI the computer serves the role of teaching machine; in CMI the computer serves as an information system with strong cooperative linkages established with the instructional team.

At the Florida State Computer Assisted Instruction Center, Hansen (1970) reported that the cost differential between CAI and CMI is something near 4 orders of magnitude. These are cost differences dramatically illustrated in Exhibit 9 which shows a comparative cost analysis for a CAI Physics course and a comparable CMI curriculum development project at Florida State University. This cost differential between the two instructional modes points to some important considerations in favor of CMI as a choice in adult education.

Exhibit 9

Costs per Instructional Hour

A. Development	$4.07	$1.04
B. Operations	1.79	.59

Table 3 - Cost Analysis for a Collegiate CAI Physics Course & CMI Course Curriculum Development Project

Category	CAI Item Cost	CMI Item Cost
Cover Preparation		
Behav. Scientists	12K	0
Writers	12K	1.3K
Physicists	6K	0
	30K	1.3K
CAI Coding		
CAI Coding Personnel	12K	4.3K
Computer Time	10K	3.5K
	22K	7.8K
Film & Graphics		
Art work & service cost	.6K	.2K
Computer Program		
Data Management Prog.	54K	0
Data Analysis Prog.	15K	0
	69K	0
CAI Instruction Cost		
CAI Computer costs	15K	.9K
Proctors	3K	0
	18K	.9K
Experimentation		
Grad Students	24K	.8K
Office & Clerical	10K	0
University Overhead	60K	0
	70K	0
TOTAL	239K	11K

(Hansen, 1970, p. 12)

The adult learning center of North Carolina State conducted the most well-known CAI application in ABE utilizing computer technology for the instruction of under-educated adults from June 1967 to June 1971. Of the 4 main tutorial uses of the computer: drill and practice, tutorial-CAI, games and simulation, and computation and problem solving, the CAI division of the Adult Learning Center selected drill and practice and tutorial CAI as being particularly applicable to adult basic education students.

Currently, CAI in any form is costly by comparison with conventional forms of instruction. The North Carolina Center found the costs of operating its IBM 1500 system at $17.00 per pupil/hour.

> To justify such increased costs it would be necessary to demonstrate that CAI can in fact bring special benefits to the ABE pupil. These benefits may be either an increase in instructional efficiency so that instructional objectives may be met with fewer contact hours with the pupil, or an increase in instructional quality so that specific learning deficiencies in ABE pupils may be identified and overcome with a resulting general increase in learning abilities of ABE pupils. (Cole, 1971.)

To attain the above overall goal of increased instructional quality for undereducated adults, the CAI division of the Adult Learning Center explored computer applications to the instruction of ABE students by:

1. the use of an IBM 1500 system for testing, Drill and Pratice, and Tutorial-CAI. This attempt was judged totally unsuccessful with strong recommendation coming from the research team: "CAI in its conventional forms should not be explored any further at present for ABE pupils." (Cole, 1971.) The recommendation is based on cost; student instructional stations are "intimidating" and unproductive for ABE pupils, and more importantly, instructional gains were not realized.

2. the use of a mini computer and modified student stations with programmed instructional materials with which the team created their own "Instructional

Process Control System." The key use of the computer in IPC is feedback control, which plays an essential role in the instructional process. This second computer application was judged far more successful with ABE students in terms of motivation, instructional gains, and student satisfaction.

Computer applications to the instruction of ABE students in the form of CAI have produced only mixed results in solving the persistent problems of individualization of instruction, increasing motivation, and hastening the learning process. Computer managed instruction can be applied less expensively, more directly, and more successfully to the task of meeting the needs of the undereducated adult. One might also add that more adults could be reached this way.

1. Computer Managed Instruction

Research in the area of computer applications to instruction has increasingly recognized that management of the instructional process is the paramount task in individualized instruction. Computerized systems for instructional management provide for more complex and more comprehensive analysis of information for instructional decision making, leading ultimately to individualized instruction.

> A system of computer managed instruction has as its objectives collecting and processing information on students and supplying this information at appropriate times and places so that it is directly applicable to human decision making. When the appropriate information is supplied to decision makers in a usable format, the efficiency of decision making and the quality of decisions can rise. (Belt and Spuck, January 1974.)

Metzel (1974) provides a substantial working definition of CMI: "We take the position that CMI is information processing, but that the information being processed is one step removed from direct instruction. CMI offers a kind of middle ground between CAI (tutorial) and administrative data processing."

To supply information, in appropriate forms, and in a timely fashion to decision makers such as administrators, teachers, and counselors, most CMI systems employ computer technology to perform 4 major functions: test scoring, diagnosing, prescribing, and reporting. A general overview of CMI systems including these 4 systems based on general features of the design is best described by Baker. (Baker, 1971.)

Researchers in CMI have all emphasized the very necessary prerequisite to the system of a well-defined and well-segmented curriculum, built around units of instruction, specified in terms of education objectives, developed instructional materials, and measuring instruments.

The quality of computer-managed instruction thus depends to some degree on:

- the identification and measurement of relevant student characteristics;
- the design of appropriate diagnostic tests;
- the availability of sufficiently complete and varied set of instructional materials;
- the association of an instructional segment with each possible combination of student characteristics and test performance. (Levien, 1972.)

Incorporation of CMI features of test scoring, diagnosing, prescribing, and reporting occurs in the following way according to Baker (1971), Spuck (1974) and others:

1. At the beginning of each unit, a pretest is taken to determine student status relative to instructional objectives. The answer sheet is read by optical scanner and scored by computer.

2. On the basis of pretest results, the student is assigned to specific learning tasks. Such assignment can be made by computer programs which implement decision rules relating test scores to learning tasks. Prescribing by computer or by teacher based on initial computer generated reports of a learning task can include any one of a number of appropriate educational experiences.

3. Progress tests are perhaps included and criterion referenced.

4. Post tests covering a unit of instruction are computer scored.

5. Reports generated by the computer after the post test include:

   a. individual student report with unit of instruction, objectives of the unit and percent the student achieved, to assess individual growth.

   b. class reports showing the proportion of students working on a specific unit and what they achieved on the post test, to assess the strengths and weaknesses of the group as a whole.

The best known CMI systems are described in detail including the student involved, mode of application, reporting capabilities, and prescriptive possibilities on the next several pages in tabular form (Exhibit 10). For detailed

information on the most current operational CMI programs, the reader is referred to the proceedings of a conference held in Chicago on November 6-8, 1974 which sought to pull together all CMI research and development underway in the academic, military, and industrial settings. Short papers detailing 22 CMI projects, some of which are being conducted in the higher education and adult education setting, are presented. (Metzel, 1974.)

A review of these best known CMI systems suggests that within CMI there are currently 3 levels of applications (Metzel, 1974):

Level I - the computer is used in a support role to tabulate and accumulate information about grades, attendance, test data. Data is handled usually in a batch processing mode.

Level II - the computer is used in a more active support role to handle records on student performance and to generate cumulative reports for both instructor and student. Some prescriptive capability is added at this level to advise students of ways of removing diagnosed deficiencies. Data is handled usually in a batch processing mode.

Level III - the computer is used in an active role to diagnose and prescribe learning activities based on student record data and stored curricular materials. This third most sophisticated level involves on-line computer capabilities.

Exhibit 10

MAJOR CMI SYSTEMS IN OPERATION

SPECIFIC CBIM SYSTEMS	STUDENTS INVOLVED	MODE OF APPLICATION	REPORTS GENERATED	TURN AROUND TIME OF REPORTS	PRESCRIPTIVE POSSIBILITIES	MAJOR PLUS OF APPLICATION
I. IMS Instructional Management System) implemented by System Development Corp. (Silberman, 1968.)	1st Grade Reading Class	Remote batch & teletype terminal in school as inquiry device	1. Individual student report 2. group report on test taken 3. weekly summary report on class	Overnight	1. Computer prescribed remedial activities when group score below certain criterion level	Direct & pragmatic method of implementing a CBIMS within normal class setting
II. IPI/MIS (Individually Prescribed Instruction/ Management and Information System) implemented by Pittsburgh Learning Research and Development Center (Glaser, 1968, 1969.)	Elementary School	Remote batch input/ output station at school	1. Student report giving pretest, progress test, & posttest within a unit 2. class report with pupil, unit, amt. of time on unit 3. unit report with names of students & objectives	1-2 Days	1. Student report gives test information and suggested activities	Strongly defined curriculum based on IPI already existed before computerization

Exhibit 10 cont'd

SPECIFIC CBIM SYSTEMS	STUDENTS INVOLVED	MODE OF APPLICATION	REPORTS GENERATED	TURN AROUND TIME OF REPORTS	PRESCRIPTIVE POSSIBILITIES	MAJOR PLUS OF APPLICATION
III. TIPS (Teaching Information Processing System) (Kelley, 1968.)	Univ. of Wisconsin Students in Introductory Economics	Batch	1. Student report includes survey test items & responses, achievement info. & series of suggested activities 2. teaching assistant report with student names, survey undertaken & description of student assignments 3. professor's report was summary of 1 & 2	A few hours	1. student prescriptions were direct giving assignment, date due, wide range of suggestions in highly readable form	1. strong prescriptive capabilities in this system capable of transfer to many other courses
IV. PLAN (Program for Learning in Accordance with Needs) implemented by American Institute for Research (Flanagan, 1969.)	Classes of Grades 1, 2, 5, 6, 9, 10 60,000 students Language Arts, Mathematics, Science, Social Studies	Time-sharing with input/output terminals in participating schools Computer Processing: IBM S/370 155 Remote Terminals: IBM 3735	Not adequately described	No information	Not adequately described, but seem to include alternative units based on scores & stored pupil characteristics	Emphasis on educational goals as related to career planning

Exhibit 10 cont'd

SPECIFIC CBIM SYSTEMS	STUDENTS INVOLVED	MODE OF APPLICATION	REPORTS GENERATED	TURN AROUND TIME OF REPORTS	PRESCRIPTIVE POSSIBILITIES	MAJOR PLUS OF APPLICATION
V. CMS (Computer Managed System) based on IMCP (Individualized Mathematics Curriculum Project) implemented by Univ. of Wisc. (DeVault, et.al. 1964, 1969.)	Elementary School Mathematics		Using simple inquiry statements, teachers can 1. list by pupil units they have attempted or mastered	No information	No listing of specific prescriptions, but lists all units for which student has completed prerequisites	Emphasis on teaching children how to plan their own learning objectives in mathematics
VI. WIS-SIM (Wisconsin System for Instructional Management) implemented by Wisconsin Research & Development Center for Cognitive Learning (Belt & Spuck, 1974.)	Elementary School Students	Batch	1. Unit performance profile summarizes achievement of each student on unit 2. grouping report lists students eligible for group & required skills 3. Expectation of student performance report 4. group instructional objectives reports 5. report on students who have not mastered skill for 6 weeks+	1. weekly 2. weekly 3. 3x a year 4. 3x a year	Based on diagnosis (process of comparing the individual's achievement record, in terms of level of mastery across objectives) extensive prescribing which includes: 1. printed materials 2. use of media 3. teacher interaction 4. group interaction 5. independent study	Very comprehensive - 5 major processes, in addition to 2 decision processes are viewed as being central to CMI: test scoring, achievement, profiling, diagnosing, prescribing, and instructing

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Exhibit 10 cont'd

SPECIFIC CBIM SYSTEMS	STUDENTS INVOLVED	MODE OF APPLICATION	REPORTS GENERATED	TURN AROUND TIME OF REPORTS	PRESCRIPTIVE POSSIBILITIES	MAJOR PLUS OF APPLICATION
VII. Computer Managed Geometry in Montgery County Schools (Morgan, 1974.)	Grades 9-12 6, 138 students 6 high schools	IBM 1500 Terminals at Schools for on-line prescription	1. Prescriptions 2. monitoring of individual progress	On-line capabilities	1. Prescription of learning activities given immediately after 1st diagnostic test 2. assessment tasks given by computer after each objective in cluster	1. Curriculum had already been well-structured before being computerized 2. larger class sizes can be accomodated with no significant difference in achievement compared to conventional setting

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Exhibit 11

MASSACHUSETTS ADULT EDUCATION
CMI SYSTEM

SPECIFIC SYSTEM	STUDENTS INVOLVED	MODE OF APPLICATION	REPORTS GENERATED & PRESCRIPTIVE POSSIBILITY	TURN AROUND TIME OF REPORTS	MAJOR PLUS OF APPLICATION
I. Rx Writer (Computer Managed Instruction) Massachusetts ABE/CMI Project	Currently operational for 900 ABE students annually at one center; In development for some 6,000 other ABE students at 6 other sites	Time-sharing Decentralized Terminals at each site PDP 11/50 Dec writer terminals	1. Individual student prescriptions 2. prescriptions by topic	On-line	1. Individual student prescriptions engaged in are stored in computerized permanent record file and linked to all attendance and demographic data

2. CMI in Adult Education

Computer managed instruction applications in an adult education setting have been implemented primarily in the higher education setting for college level courses. The Massachusetts CMI project and one at Canadore College in Ontario are attempting to use computer technology in an ABE setting. These courses have used diverse approaches, but rationale for computer managed instruction include the following:

1. concern for individualized, personalized, or flexible education
2. need for assistance in the management aspects of the learning process.

Based on a philosophy of individualized instruction, Ohio State University and South Dakota State University implemented a computer manager instructional model for introductory biology courses. Students progressed at their own rate and received credit upon completion of the course. Elements of the application include: programs which diagnose student starting points and specify learning goals; course materials available on-line or in a prescribed form; instructor reports which permit review of student progress for instruction modification. The major contribution of this model is "an effort to insure the model's adaptability to any content area at any level." (Allen, 1972.)

The Capital Area Career Center in Mason, Michigan is employing computer management to individualize instruction in the occupational setting. An extensive job task analysis provided data on skills, knowledges, behaviors, and equipment needed for performing an occupation. This data was computerized. Learning prescriptions for each student are based on a student's competancies as compared with task analysis for a selected occupation. Computer written reports on student progress are provided to each instructor. (Danford, in Metzel, editor, 1974.)

At Canadore College in Ontario, the Adult Basic Education program is using computer assistance to evaluate on-going student progress through "computer based, criterion-referenced logitudinal testing." Computer reports are also generated to produce other detailed enrollment information and absence reports. This effort has been launched by the staff to provide individualized learning and to afford a second chance in an environment different from the traditional school setting in which the adult has previously experienced failure. (Dudgeon, 1973.)

Florida State University at its computer-assisted instruction center is conducting substantial research in the applications of computer technology to instruction. Activities include: CAI, CMI, combinations of the two, and computer based learning information retrieval systems. Research at the center has been funded by three sources: Office of Naval Research, Department of Health, Education and Welfare, and Florida Division of Instructional Research and Service. The CMI projects include: a graduate level course in the techniques of programmed instruction; an undergraduate course in Health Education; social work education courses; a teacher education course for special needs children; a teacher education course for elementary teacher preparation, and an educational psychology course. A brief discussion of these various CMI efforts follows.

In an undergraduate course in Health Education at Florida State University, a comparison was made between computer managed instruction and conventional instruction. Three CMI prescription treatments were administered. Pre and Post tests were taken by the students on-line at a terminal. During the academic term, CMI used appropriate self-instructional materials. Final results showed a general superior performance of CMI groups. (Lawler, 1972.)

Coupled with clinical experience, a CMI course was designed at the Florida State computer assisted instruction center to prepare teachers in the area of

special education. Competency based instructional modules were built around pre and post tests, behavioral objectives and materials. The modules concept provided a format for CMI. (Schwartz and Oseroff, 1972.)

In two courses at the Florida State University instructional lab, a combination of CMI and CAI approaches was investigated. A general education physics course was conducted with both forms of assistance and demonstrated that: involvement with CAI produces better grades, and computer managed instruction in combination with CAI provides a very cost effective approach. (Krombrout, 1970.)

In a graduate level course at Florida State to teach the techniques of programmed instruction, a CMI system most closely resembling the typical model of CMI discussed in this paper including diagnostic testing, remedial prescription, and record keeping, demonstrated that student performance was enhanced. Additionally, the cost of conducting the course via CMI was estimated to be one-half to one-third the cost of conventional instruction (Hagerty, 1970). This cost finding is similar to that found in Montgomery County Public School geometry CMI project in which larger numbers of students could be accomodated in each group with no declines in student achievement. (Morgan, 1974.)

In a social work education course at Florida State, computer management was used to test students at program admission and suggest diagnostic methods. CAI was developed to assist in the problem areas revealed through the CMI diagnosis. One notable feature of the Florida State experiments are the integrated efforts of a CMI and CAI approach. The two are used in combination to provide maximal quality in the learning experience.

Florida State University, unlike many other applications heretofore discussed, employs the most sophisticated form of CMI, the on-line use of the computer as a "real-time diagnostician and prescriber for the student." The student interacts directly with the computer for maximally efficient evaluation of his or her learning experiences.

A review of the research concerning CMI efforts reveals several interesting, though preliminary findings:

1. CMI can be cost-effective, especially considering the use of batch mode for generating reports and prescriptions. CMI can be cost-effective in comparison with conventional instruction, and especially in comparison with CAI instruction.

2. Given suitable organization and development, CMI can effectively individualize the learning experiences of students.

3. CMI can enhance the learning experience of students.

4. CMI can assist teaching staffs considerably in the management aspects of the educational experience.

5. CMI can be used in combination with CAI to expand instruction possibilities for students.

3. CMI in the Massachusetts ABE Setting

Individuals involved in the National Adult Basic Education Program grapple daily with the pressing need to develop techniques, methods and materials to remedy the basic skill deficiencies of undereducated adults. In an ABE Learning Center, program administrators and teachers need to respond simultaneously to several client needs:

1. An adult having failed in a traditional setting with traditional methods needs innovative methods and materials.
2. This adult seeks to attain his goals in a relatively short time.
3. As an adult, he requires instruction responding to his specific needs.
4. As an adult, he is accustomed to assuming responsibility, yet in the area of education he has not as yet succeeded in directing his own learning activities.

As a response to these several needs, ABE administrators and teachers should consider computer assistance in the instructional process:

> The computer is capable of individualizing instruction in a way that no other currently known system can -- not even a personal tutor. It can collect data and store it more completely and accurately, and use it more extensively than a person can. The computer can consider all the variables represented by the collected data, weigh the importance of their relevance to the learning prescription appropriate for an individual learner, and then rapidly adapt what it "knows" to a program of learning for a specific, individual student. Moreover, this data collection and analysis, and learning program adaptation can take place at the same time as the student proceeds through a given unit of instruction. (National Extension Association, 1968.)

Computer Managed Instruction has special relevance to Adult Basic Education, especially in a comprehensive learning center environment with adults of diverse levels and goals attending. Open from 9 a.m. - 9 p.m. with students attending often on a drop-in basis, learning centers may have adults learning basic literary and computational skills, adults learning geometry and science in preparation for

the high school equivalency, and non-English speaking adults, all working simultaneously in an open classroom setting. Materials and media available at the center for these adults are numerous and varied. Administrators, counselors and trained teachers, often a nuclear full-time staff coupled with part-time individuals, are all available as resource people.

The prime goal of a computer managed instruction application in an ABE setting may be stated as the selection of appropriate educational experiences:

> The selection of appropriate educational experiences is a complex decision involving such parameters as student need, learning style, and motivation, teacher availability, alternative instructional activities for the objective, and the presence of the students with the same need. The object is to select educational experiences for the student which maximize educational benefit while considering the availability of human, material and financial resources. (Spuck and Belt, 1974.)

The Massachusetts design for computer managed instruction in ABE learning centers seeks to provide the most appropriate educational experiences based on individual student need and available resources. An overview of the Massachusetts CMI system is provided in Exhibit 11. The pioneering center, the OWL center in Springfield designed PROG, an abbreviation for Program, a computer managed instruction program designed to segment the ABE and GED curriculum into meaningful units based on behavioral objectives. Initial and programs tests already available at the center were tied into the model. Considerable success has been seen at the Springfield Learning Center in: 1. individualizing the learning activities of a diversified ABE population; 2. assisting center staff in management of instruction; 3. facilitating a self-direction of learning on the part of ABE students.

Development from this first effort has been sought at 5 other learning centers in the state. The following describes the design of the CMI system as it is to be developed and implemented at the other centers:

1. The curriculum is defined and designed by each center. In most cases this will probably include separate curricula for ABE math, GED math, Basic Reading, Advanced Reading, GED preparation. The curriculum is structured by subject, class, topic and level.

2. Once defined by a center, the curriculum is inputed on-line at each site.

3. Learning prescriptions, based on teacher diagnoses of student need, are manipulated and generated based on curriculum stored in the computer.

4. All prescriptions a student uses are recorded in the student's permanent record file in the computer.

Advantages of the system design include:

1. The system is integrated into the normal functioning of a learning center. Materials and resources already available at a given center are used. Existing curricular designs can be used and computerized. Existing staffs can be employed to do the basic curricular breakdown and computer input.

2. Prescriptions are continually available because of the on-line nature of the application. Success is readily and immediately obtained. Meaningful responses can be made to students participating in a drop-in fashion.

3. A record of learning activities, attendance data, and record keeping data is computerized and immediately accessed by unique student number.

Several problems have been encountered in the development of this CMI application: the development and organization of the curriculum requires considerable time, effort and training on the part of the learning center staffs; uses of the terminal for more immediate administrative functions have caused instructional functions to be secondary in importance; sufficient personnel trained in computer applications in general and CMI in specific is needed to hasten and encourage the implementation of the project; computer down-time and hardware problems have presented added frustrations to the centers.

At one center, development of a computerized math curriculum for ABE, Pre-GED and GED students has been underway. Focus on this math curriculum would

provide an excellent means of viewing the CMI design as a whole. The center's math curriculum for ABE and GED math had already been structured into topics and objectives through the coordinated effort of a math specialist teaching at the center, teaching staff, and computer field coordinator. All materials currently available at the center had been linked to topics. Like most major operational CMI systems, considerable development had occured before the prospect of computerization. For computerization in the system, the curriculum has been structured into subject, class, topic and level:

Subject: Mathematics

Class:
- Basic Math
- Fractions
- Decimals
- Algebra
- Modern Math

Topics: (Because these are quite detailed only some of the topics under the class, fractions, are listed below)
- Fractions: definitions
- Multiplication of Fractions: No Reducing
- Greatest Common Factor
- Equivalent Fractions
- Comparing Fractions
- Reducing Fractions
- Cancellation
- Common Denominators
- Addition of Fractions: Same denominator

Levels:
- Beginning
- Instructional
- Review
- Test

Exhibit 12 is taken from a printout of the first four topics, Fraction Definition, Multiplication of Fractions, Greatest Common Factor, Equivalent Fractions, with appropriate levels under the class, fractions. Exhibit 13 is taken from a printout of individual learning prescriptions as they would be given to a student. Example I is a learning precription for a student working to review fraction definitions. Example II is a learning prescription for a student needing instruction on the topic greatest common factors.

For the student participating in a program at this learning center, the sequence of events in his or her learning program would be described as follows:

1. the student participates in center orientation and takes placement test.

2. on the basis of initial assessment through placement testing, the student is assigned to a resource teacher or to an appropriate small class.

3. the resource teacher, guided by the placement test, and after interaction with the student will diagnose the student's learning needs in a particular subject area and then use the computer terminal to extract by code from the data base all that is available at the center to respond to that student's needs.

4. the teacher will use the computer printout of the prescription(s) to assign the student a series of learning activities.

5. a record of the selected prescriptions will be stored in the student's record file.

6. the teacher will serve as a resource, monitoring student progress and reassigning prescriptions as needed.

Exhibit 12

MATHEMATICS TOPICS

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RX FUNCTION? PRINT

SUBJECT (TWO-LETTER CODE): MA
MA IS SUBJECT MATHEMATICS
CLASS: B
CLASS FRACTIONS
TOPIC   1 FRAC DEFIN
LEVEL   1 BEGINNIN
B; PP 1 AND 3
/EXCELLENT
/REFER QUESTIONS TO RESOURSE TEACHER
/UPON COMPLETION PROCEED TO INSTRUCTIONAL LEVEL

LEVEL   2 INSTRUCT
A; P. 8-14
/E
K;
/E
/SEE RESOURCE TEACHER IF FURTHER MATERIAL IS NEEDED
/PROCEED TO REVIEW UNIT FOR SPOT TESTING
G; P. 1
K; P. 1
Q; PP. 69
/EXCELLENT
/SEE TEACHER FOR PROGRESS EVALUATION ON FRACTIONS
/PROCEED TO NEXT TOPIC

LEVEL   3 REVIEW
Q; P. 77
/G
R; P. 33
S; P. 26
/G
/AFTER SUCCESSFUL COMPLETION OF PROGRESS TEST PROCEED TO NEXT TOPIC
R; P. 27
/EXCELLENT
U; PP. 89-90
/EXCELLENT
/SEE TEACHER FOR FINAL REVIEW OF FRACTIONS
/PROCEED TO NEXT TOPIC
```

Exhibit 12 cont'd

```
TOPIC   2 MULT/NO RED
LEVEL   1 BEGINNIN
Q; P. 73
/EXCELLENT
/PROCEED TO INSTRUCTIONAL LEVEL

LEVEL   2 INSTRUCT
Q; P. 74
/EXCELLENT
B; P. 16
/GOOD
/SEE TEACHERS FOR PROGRESS EVALUATION
/PROCEED TO NEXT TOPIC IF COMPLETED SUCCESSFULLY

LEVEL   3
R; P. 31
/GOOD
S; P. 25
/GOOD
/SEE TEACHERS FOR PROGRESS TEST
/PROCEED TO NEXT TOPIC


TOPIC   3 GR/COM/FACTOR
LEVEL   1 BEGINNIN
/EXCELLENT
/PROCEED TO INSTRUCTIONAL LEVEL

LEVEL   2 INSTRUCT
A; P. 8-14
K; P. 4-14
/SEE TEACHER FOR PROGRESS TEST
/PROCEED TO NEXT FRACTION TOPIC IF COMPLETED

LEVEL   3 REVIEW
Q; P. 77
R; P. 33
/GOOD
S; P. 26
/GOOD
/SEE TEACHER FOR PROGRESS TEST
/PROCEED TO NEXT FRACTION TOPIC AFTER SUCCESSFUL COMPLETION
```

Exhibit 12 cont'd

```
TOPIC   4 EQUIV/FRAC
LEVEL   1 BEGINNIN
B; PP. 4-6
/PROCEED TO INSTRUCTIONAL LEVEL

LEVEL   2 INSTRUCT
B; P. 7
/EXCELLENT
C; P. 1 and 2
/EXCELLENT
Q; PP. 75 and 76
/EXCELLENT
/SEE TEACHER FOR PROGRESS TEST
/PROCEED TO NEXT FRACTION TOPIC UPON SUCCESSFUL COMPLETION

LEVEL   3 REVIEW
G; P. and 4
/GOOD
K; P. 2
/GOOD
R; P. 32
/GOOD
R; P. 32
/GOOD
/SEE TEACHER FOR FINAL PROGRESS TEST
/PROCEED TO NEXT FRACTION TOPIC
```

Exhibit 13

SAMPLE FRACTION UNIT PRESCRIPTIONS

(EXAMPLE I)

MATHEMATICS FRAC DEFIN
GREEN SPECTRUM
P. 77
G
BLUE SPECTRUM
P. 33
G
PURPLE SPECTRUM
P. 26
G
AFTER SUCCESSFUL COMPLETION OF PROGRESS TEST PROCEED TO NEXT TOPIC
BLUE SPECTURM
P. 27
EXCELLENT
CAMB GED
PP. 89-90
EXCELLENT
SEE TEACHER FOR FINAL REVIEW OF FRACTIONS
PROCEED TO NEXT TOPIC

(EXAMPLE II)

MATHEMATICS GR/COM/FACTOR
S&P FR A&S
P. 8-14
D&S INTEGERS
P. 4-14
SEE TEACHER FOR PROGRESS TEST
PROCEED TO NEXT FRACTION TOPIC IF COMPLETED

CONCLUSION

Further investigation needs to be conducted in the area of uses of the computer as an instructional aid in Adult Education. Preliminary evidence already exists from several operational demonstration projects that the use of the computer as an educational manager may provide an effective, cost-feasible approach to individualization of the learning experience in the adult education setting. Computer managed instruction holds several promises including: improvement in effective delivery of instruction to students with diverse abilities and preparations; increase in student responsibility for learning experiences; increase in teacher flexibility and availability to students by reducing more cumbersome and routine management tasks.

Unquestionably, the combined factors of greater program accountability; increased reporting requirements; increased demands for program control, and need for accessible program information will hasten developments in the area of administrative computer applications in Adult Education. Essentially, three levels of computer capability will be required to meet the above administrative needs: capability to process quanitities of data; capability to determine patterns among groups of data, and capability to structure research and decisions based on available data. Computer technology will be applied increasingly in Adult Education to relieve the drudgery of repetitive administrative work, to provide comprehensive management information systems, and most importantly, to greatly improve the quality of decision making.

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